A testimonial of successful projects in the field of the cluster "Food, Bioeconomy, Natural Resources, Agriculture and Environment"

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UNIVERSITÀ DI ROMA

Horizon Europe

Work Programme 2021-2022

9. Food, Bioeconomy Natural Resources, Agriculture and Environment

DRAFT

Research and Innovation in EU Projects (Horizon 2020 and BBI-JU)

REsources from URban BIo-waSte (RES URBIS)

H2020 Call CIRC-05-2016: Unlocking the potential of urban organic waste (RIA)

GA 730349, 3 years, 2017-2019, 20 partners, 8 countries.

EU Grant: 2 996 688 €

Coordinator: Mauro Majone, Sapienza Università di Roma, Italy

www.resurbis.eu

No Agro-Waste - Innovative approaches to turn agricultural waste into ecological and economic assets (NoAW)

Call: WASTE-7-2015 - Ensuring sustainable use of agricultural waste, co-products and by-products (RIA)

GA 688338, 4 years, 2016-2021, 32 partners, 15 countries

EU Grant: 6 887 570 €

Coordinator: Nathalie Gontard, INRAE, Montpellier, France

https://noaw2020.eu/

USABLE PACKAGING

Unlocking the potential of Sustainable BiodegradabLe Packaging

Call:BBI.2018.SO3.R10 Develop bio-based packaging products that are biodegradable/ compostable and/or recyclable

GA 836884, 2019-2022, 25 partners, 10 countries

www.usable-packaging.eu/

Coordinatore: Josè Maria Lagaron, Consejo Superior de Investigaciones Cientificas (CSIC) , Valencia, Spain.

Horizon 2020 - Work Programme 2016 - 2017

CIRC-05-2016: Unlocking the potential of urban organic waste

REsources from URban BIo-waSte

RES URBIS

(RIA, EU Grant Agreement 730349)

3-year project, 2017-2019

20 partners, 8 countries

Project coordinator

Mauro Majone

Università di Roma "La Sapienza", Italia

website: www.resurbis.eu

CIRC-05-2016: Unlocking the potential of urban organic waste

In a Circular Economy perspective, turning waste into a resource is an essential part of increasing resource efficiency and closing the loop

More than 70% of Europeans live in cities and urban areas, and produce huge amount of organic waste (**including sludge from wastewater treatment**)

Challenges from the Call which RES URBIS aims at answering to

Can different organic waste streams of urban origin combined into a common valorization chain?

Can bio-based products be obtained from organic waste of urban origin, with a higher economic value than compost and biogas?

Can both targets be fullfilled togheter?

Can the new technological solutions be integrated in the present waste management systems

RES URBIS aims:
developing an urban bio-waste biorefinery

To integrate in one single technology chain the valorization of most relevant organic waste of urban origin, i.e. OF-MSW, wastewater sludge, park/garden waste, and possibly residues from food-processing industry.

To develop an urban organic waste biorefinery towards bio-based products, with **higher value than biogas and compost** (while not disregarding them at the end of the chain). By developping an integrated urban biorefinery, its minimal operating capacity is achievable in smaller waste collection areas.

Also taking care of

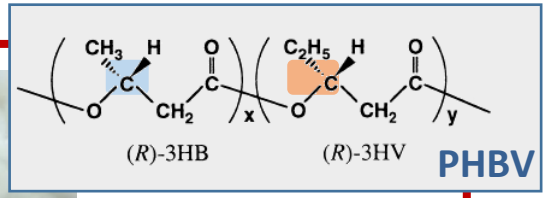
✓the whole technology chain	**Different industrial sectors to be linked each other**, each one with its business targets, needs and specifications.
✓territorial conditions	Affordable economic strategies to be tailored on territorial **clusters**, e.g. where available "feedstock " is large enough
✓technical and non technical constraints	Regulatory ("end of waste"), environmental, and social constraints, as function of local and national conditions

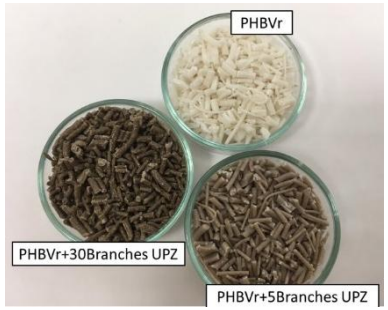
FROM URBAN ORGANIC WASTE

- **the organic fraction from separate collection of municipal solid waste** (**55 g TS/d from OFMSW**)
- **excess sludge from treatment of urban wastewater** (**39 g TS /d from WWS**),
- garden and park waste
- waste from food-processing facilities (namely fruit waste)

TO BIO-BASED PRODUCTS

- **polyhydroxyalkanoate (PHA), a biodegradable natural biopolymer**
- related PHA-based bioplastics (e.g through blends)
- fibers (to be also used for PHA-based biocomposites).
- bio-based solvents (to be also used in PHA extraction)





Why focusing on PHA (namely PHBV)?

Two problems: **- urban organic waste to be recycled**
- oil-based plastics to be replaced and/or recycled

One solution: **- converting urban organic waste into biodegradable plastics,**
- to partially replace oil-based plastics, and
- to be recycled along with organic waste

Well aligned to European policies (Circular Economy, Waste Directive, Plastic Strategy)

Appealing: PHA is 3 times "Bio"

- Produced from renewable feestock (**but no food**)
- Produced through biological process (**but no OGM**)
- Easily and "truly" **biodegradable**

and it's not recycled: it's virgin material

Applications and economics

High market potential, as higher as more PHA cost decreases; but still PHA value to be higher than biogas and compost

Already under investigation at TRL 5-6

Technology readiness levels (TRL)

Where a topic description refers to a TRL, the following definitions apply, unless otherwise specified:

TRL 1 – basic principles observed

TRL 2 – technology concept formulated

TRL 3 – experimental proof of concept

TRL 4 – technology validated in lab

TRL 5 – technology validated in relevant environment (industrially relevant environment in the case of key enabling technologies)

TRL 6 – technology demonstrated in relevant environment (industrially relevant environment in the case of key enabling technologies)

TRL 7 – system prototype demonstration in operational environment

TRL 8 – system complete and qualified

TRL 9 – actual system proven in operational environment (competitive manufacturing in the case of key enabling technologies; or in space)

Taken from
HORIZON 2020 – WORK PROGRAMME 2014-2015 General Annexes

High Technology Readyness Level (TRL 5-6): pilot scale investigation is a key-feature of RES URBIS approach

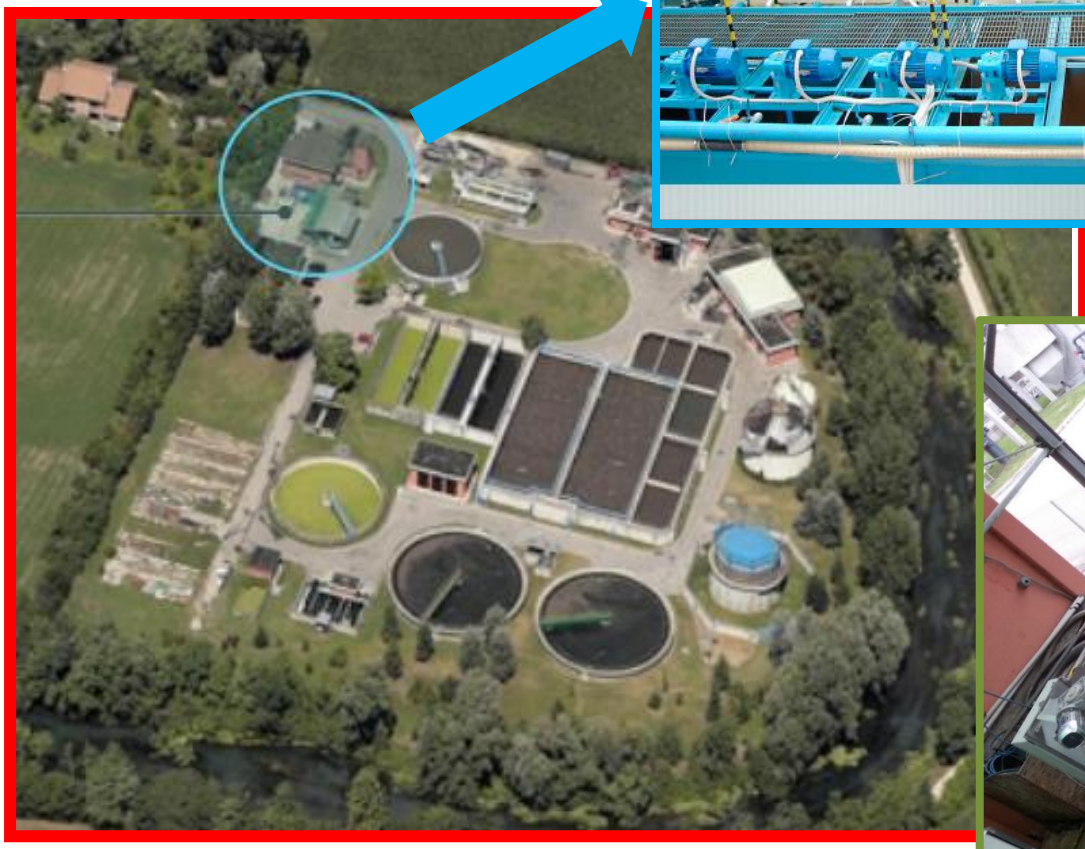
- **Two multi-step pilot plants for production of PHA**
- **Working with real and representative feedstock**
  - ✓ **Mixture of OFMSW and excess sludge from WWTP**
  - ✓ **Fruit processing waste**

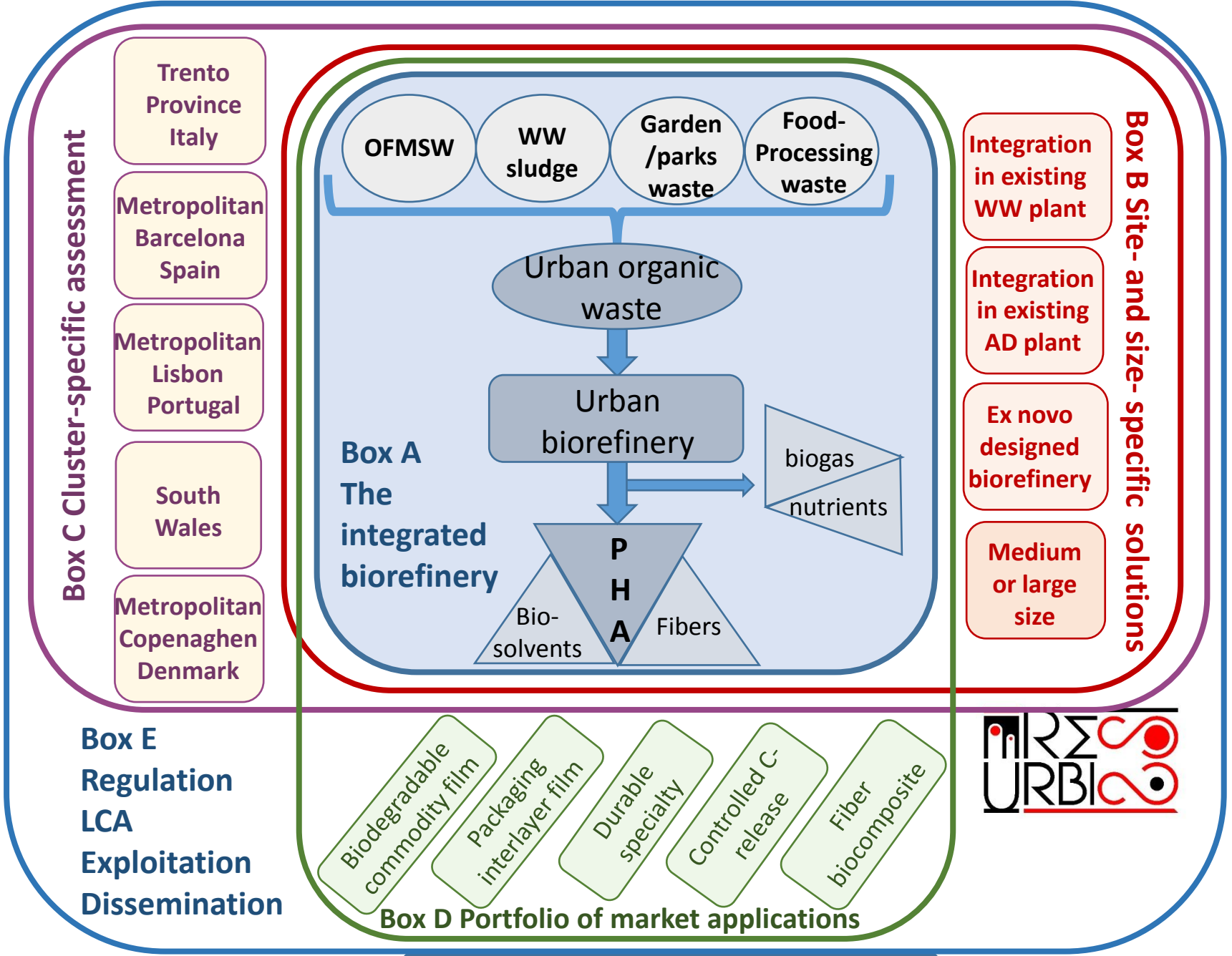
Plus three plants for acidogenic fermentation

Pilot scale investigation with real feedstock was a key feature of RES URBIS (TRL 5-6)

Pilot plant at wastewater treatment plant of Treviso (held by Alto Trevigiano Servizi, ATS)

Cooperation among Universities of Rome, Venezia and Verona

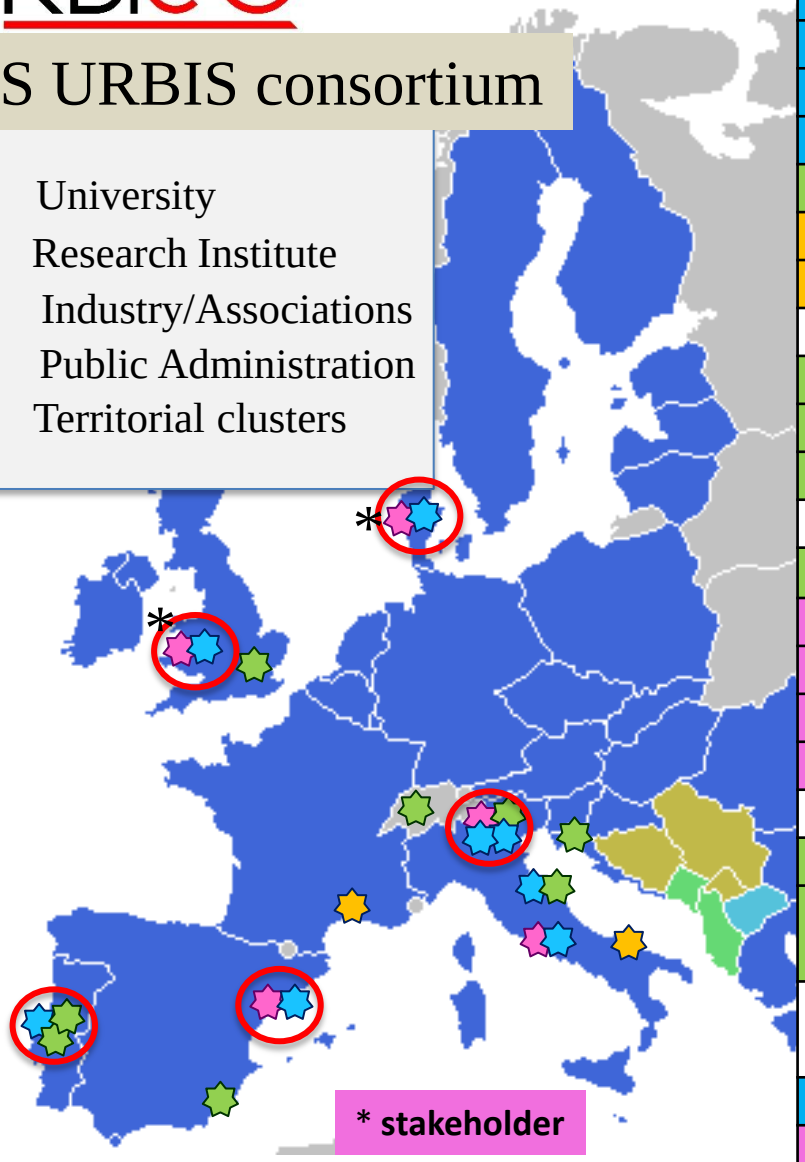




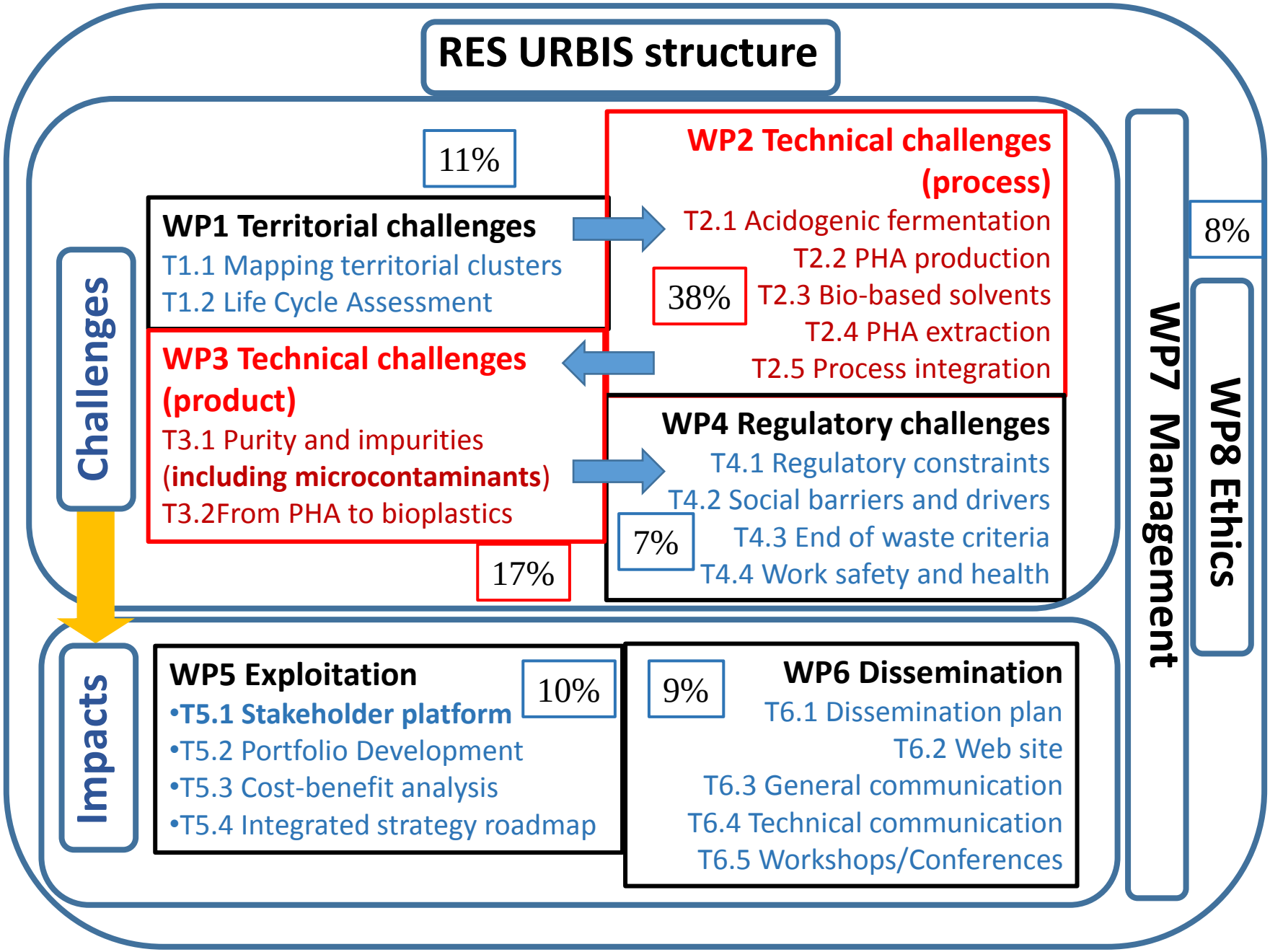
The RES URBIS box-model

RES URBIS consortium

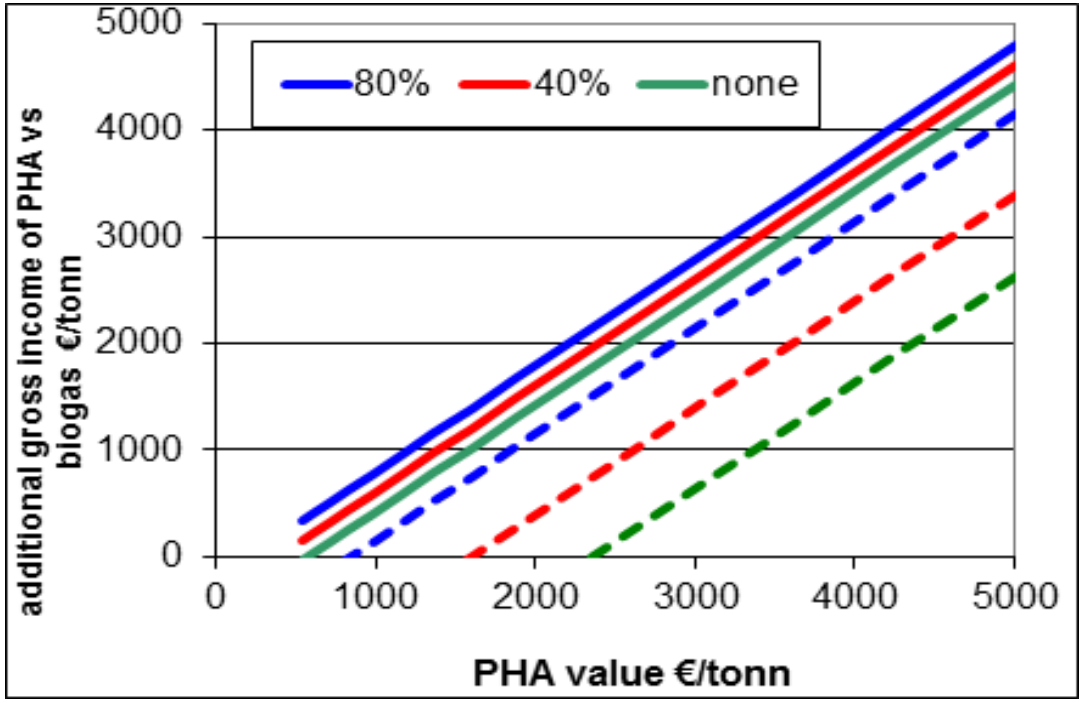
- University
- Research Institute
- Industry/Associations
- Public Administration
- Territorial clusters



Process-related challenges	
University of Roma "La Sapienza" (Italy)	WP2
New University of Lisbon (Portugal)	
University Ca Foscari of Venice (Italy)	
University of Barcelona (Spain)	
University of South Wales (UK)	
University of Bologna(Italy)	
Biotrend (Portugal)	
CNR – IRSA(Italy)	
Inst. Nat. Recherche Agronomique (France)	
Product-related challenges	
BioInicia (Spain)	WP3
Mi-Plast (Croatia)	
SABIO (Italy)	
Territorial clustering	
Aguas do Tejo Atlantico (Portugal)	WP1
Barcelona Metropolitan Area (Spain)	
Province Autonoma di Trento(Italy)	
Rhondda Cynon Taff County Council (UK) *	
City of Copenaghen (Denmark)*	
Economics and exploitation	WP5 WP6
InnoExc (Switzerland)	
Bio-Based and Biodegradable Industries Association (UK)	
Regulation, safety, environmental and social aspects	WP1 WP4
Technical University of Denmark (Denmark)	
National Institute for work safety (Italy)	
University of Verona (Italy)	


RES URBIS structure
Challenges
11%
WP1 Territorial challenges
T1.1 Mapping territorial clusters
T1.2 Life Cycle Assessment
WP2 Technical challenges (process)
T2.1 Acidogenic fermentation
T2.2 PHA production
38%
T2.3 Bio-based solvents
T2.4 PHA extraction
T2.5 Process integration
WP3 Technical challenges (product)
T3.1 Purity and impurities (including microcontaminants)
T3.2From PHA to bioplastics
17%
WP4 Regulatory challenges
T4.1 Regulatory constraints
T4.2 Social barriers and drivers
7%
T4.3 End of waste criteria
T4.4 Work safety and health
Impacts
WP5 Exploitation
10%
•T5.1 Stakeholder platform
•T5.2 Portfolio Development
•T5.3 Cost-benefit analysis
•T5.4 Integrated strategy roadmap
9%
WP6 Dissemination
T6.1 Dissemination plan
T6.2 Web site
T6.3 General communication
T6.4 Technical communication
T6.5 Workshops/Conferences
WP7 Management
8%
WP8 Ethics

RES URBIS impact



Additional income of PHA production with respect to biogas as function of PHA value on the market.

The calculation refers to present market value of biogas with incentives (dotted line) or without (full lines). Line colors refer to possible recovery of biogas from PHA production residues, at different percentage. Income only, PHA production costs not included.

According to a recent study on population distribution in Europe (BBSR 2011), there are 115 Metropolitan Areas that have more than 500.000 inhabitants each and an average size of 3 million. Thus around 343 million people live in metropolitan areas that have a suitable size to exploit the RES URBIS approach, which means a potential of producing 2,2 million ton PHA per year and 8.8 billion €

Little hints (I)

- **To partecipate**….. Starting from preliminary events (es. infodays, brokerage…)
- **To take the initiative**. If needed/useful, by self-candidating for **coordination**.
- **To gain confidence with the format (excellence, impact, implementation)**

https://ec.europa.eu/info/funding-tenders/opportunities/docs/2021-2027/horizon/temp-form/af/af_he-ria-ia_en.pdf

- **It's never too early to start.**

- **To directly write down the rationale of the proposal**.
- To clearly and specifically answer to any sentence of the call (**any word counts**…)
- To also take into account the general frame (**strategic plan**, **workprogramme and EU policies)**.
- To take care of the nature of the call (**RIA, IA, CSA**) and of **TRL (starting and final)**.
- To well highlight which are the **strong points** of the proposal (**excellence**).
- To well highlight **impacts**, **in a quantitative way,** and with reference to environmental, economical and social aspects.
- **Don't promise too much:** if approved, the project will have to be realised!
- **Multiactor**. Good balance among research bodies, companies (especially SMEs), public administration, NGO.
- **Start with a few core partners**, then look for missing competencies
- While completing partner consortium, take care of good balance of partners and budget among different countries.

KEY ELEMENT OF THE IMPACT SECTION

SPECIFIC NEEDS	EXPECTED RESULTS	D & E & C MEASURES
What are the specific needs that triggered this project?	What do you expect to generate by the end of the project?	What dissemination, exploitation and communication measures will you apply to the results?

TARGET GROUPS	**OUTCOMES**	**IMPACTS**
Who will use or further up-take the results of the project? Who will benefit from the results of the project?	*What change do you expect to see after successful dissemination and exploitation of project results to the target group(s)?*	*What are the expected wider scientific, economic and societal effects of the project contributing to the expected impacts outlined in the respective destination in the work programme?*

Little hints (II)

Take care of and possibly introduce new ideas also for:

- **Ethics (including privacy)**
- **Gender dimension (not only Gender Equity Plan)**
- **Interaction among science and humanities**
- **Data Management (Data Management Plan, Open Science)**
- **Environmental sustainability (Do no significant harm)**
- Communication, dissemination, **training**.
- **Responsible Research and Innovation**

Little hints (III)

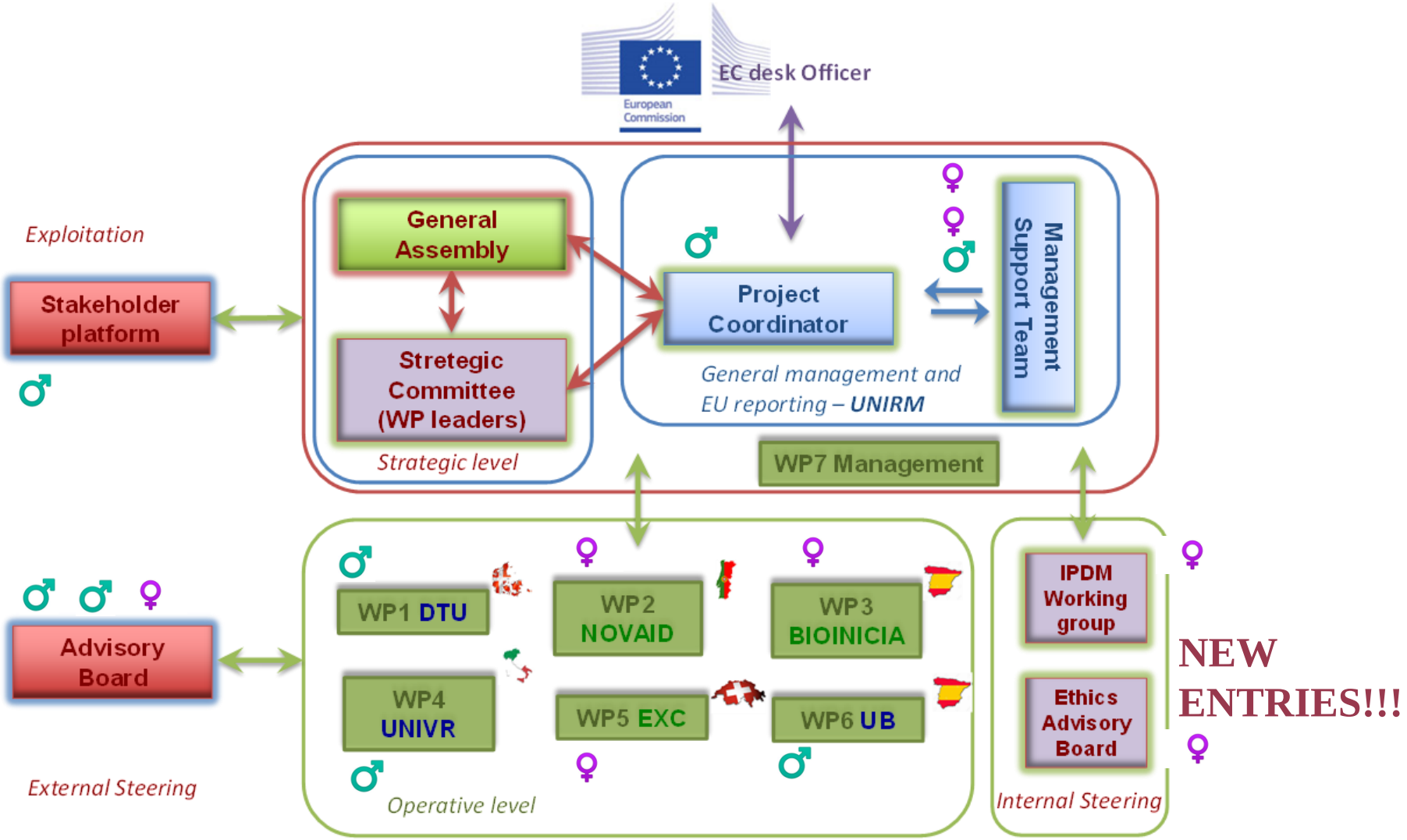
Implementation:

- Appropriate organization of workpackages and tasks. **Don't exceed!**
- Appropriate number of deliverables (D) and milestones (M), homogenously distributed along the project. **Don't exceed!**
- Clear distinction between D and M roles. Personally, I prefer to insert a M as key choice to be taken based on D(s) results; hence Ms follow Ds.
- In 3-6 months from project start, several Deliverables have to be released: usually project management plan, data management plan and IPR protection, dissemination and communication plan, ethical aspects and stakeholder platform management

- **Great attention to partner interactions, especially with reference to any exchange of samples, materials, prototypes or even procedures. Dealing with samples, define clearly needed amounts to be supplied (1g-1kg-100 kg?) and their time schedule.**
- **Include shipping costs and consider any problems at national borders.**
- **Define well interactions among «experimentals» e «modellers»; the latter usually look for data that the first ones don't have at hand, e.g. for Life Cycle Assessment.**
- **Make a realistic and robust Contingency plan to cope with delays**

- **MAKE YOUR MANAGEMENT AS MUCH ROBUST AS POSSIBLE!**
- **Project manager**
- **Montly web-meeting among partners or at least among WP leader.**
- **Don't exagerate with internal reports. There are already many D and M to be produced for the EU.**

Consortium governance

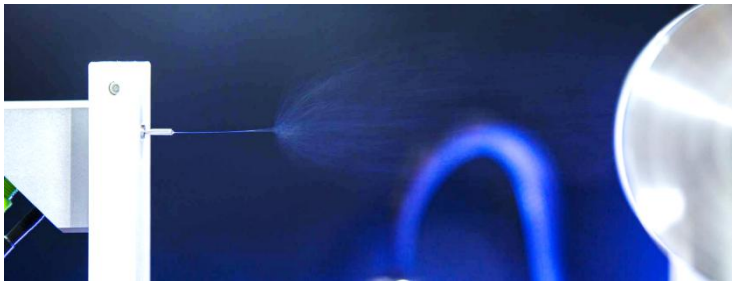


RES URBIS consortium governance

Main results (I)

✓Long-term continuous PHA production is technically demonstrated at pilot scale, starting from true biowaste (2 pilot plants in operation in Treviso and Lisbon) **(WP2)**

✓Three novel extraction methods have been developped and one scaled up **(WP2)**



✓Based on electrospinning processing, applications as interlayer film, and the “adjacent” adhesive market, have shown high market potential **(WP3)**

✓3 generations of PHA batches have been prepared (> 30 kg) and characterised **(WP2/WP3)**

✓Compounded PHA can be used for commodity films and durable goods, under tests for mechanical properties. Biocomposite with fibres from park/garden waste **(WP3)**

✓ Data on microcontaminants in PHA (metals, PAH, PCB) show they meet present regulatory standards and guidelines. Slight improvement is needed for direct food contact **(WP3)**

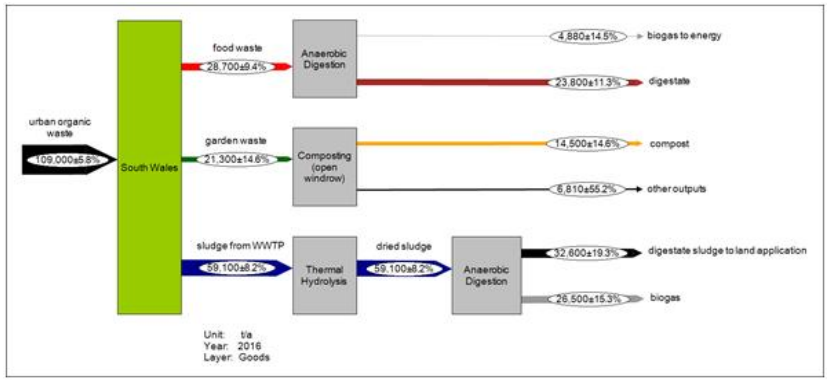
Main results (II)

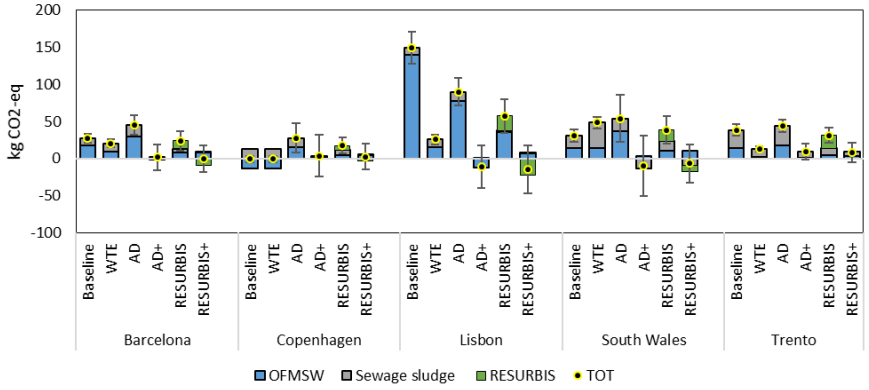
✓The regulatory framework (namely waste legislation and CLP/REACH) has been analysed and barriers/gaps individuated (SWOT analysis). The **regulatory scenario is quite favourable,** but for the need to define "end of waste" status at least at national level.

A preliminary dossier has been prepared for this purpose (WP4)

✓The present waste/sludge management systems of the 5 territorial clusters have been described and post-RES URBIS scenarios defined.

An overall potential for around 30.000 ton PHA/y has been estimated (WP1).



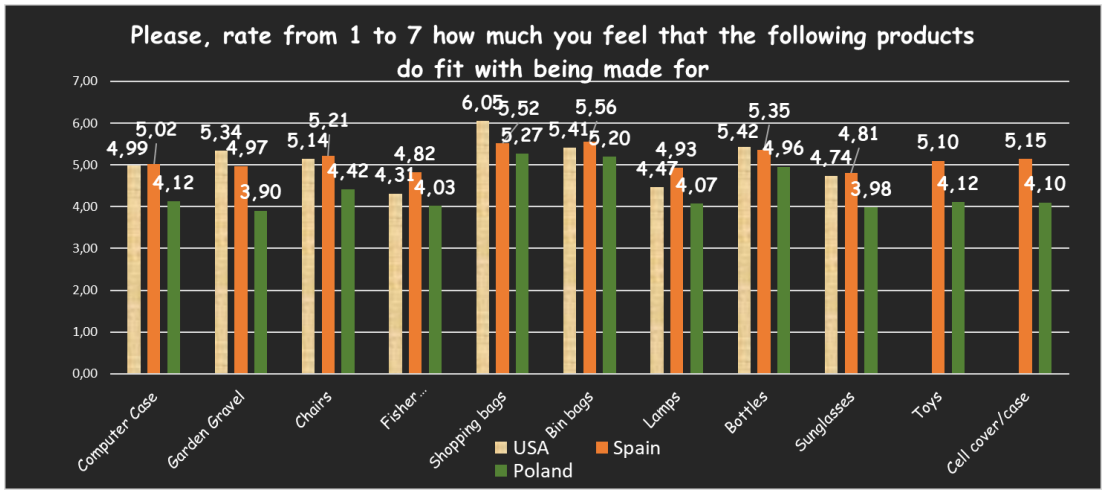


✓The Life Cycle Assessment has shown that the RES URBIS biorefinery has a **negative environmental burden**, meaning that the energy and the material consumed for the production of PHA are **less impacting** than replacing the production of fossil plastic **(WP1)**

✓Technical economic analysis has been made about upgrading AD plants with RES URBIS technology chain, with reference to an existing plant for each territorial scenario. This solution proved to be **viable at a PHA price of 3 €/kg**, and even less under most favourable conditions **(WP5)**

Main results (III)

✓Based on consumer polls, **social perception and willingness to pay are good (WP4)**



✓ An intense dissemination has been made at several levels (scientific, technical, general audience), so contributing to the diffusion of novel concepts of waste management and **resource recovery in a circular economy (WP6)**

✓A Stakeholders Platform has been established and all projects results have been exchanged and discussed in several meetings **(WP5).**

✓ **Looking for investors to realize a demo-scale plant…..**

RES URBIS at a glance

Question	Answer	Comments
Is the PHA production from organic waste technically feasible?	**Yes**	At pilot scale, and robust enough
Can it be integrated with existing waste treatment plants	**Yes**	Retrofitting of plants for increasing their capacity
Is it economically affordable?	**Yes**	At a cost of 3 €/kg and even less in favourable conditions
Is it environmentally sustainable?	**Yes**	Based on LCA, negative enviromental burden
Is it acceptable in a consumer perspective	**Yes**	Good willingness to purchase
Can it be implemented under present regulation	Yes	But «end of waste» criteria to be defined yet
Is it well aligned to European policy (i.e. Circular Economy Package, European Plastic Strategy)	**Yes**	Policies for biodegradable plastic and sludge management to be better defined
Is the produced PHA suitable for intended applications?	**Yes**	Potential for replacing oil-based plastics, but not of general purpose
Does a market exist for PHA from organic waste	**Yes**	High potential for selected applications, but not of general purpose

Grazie dell'attenzione

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